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User acceptance of software as a service: Evidence from customers of China's leading e-commerce company, Alibaba

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ABSTRACT

This paper proposes a model with which to analyze the user acceptance of Software as a Service (SaaS). To develop this model, empirical surveys were conducted through four rounds of questionnaires obtained from customers of China's leading e-commerce company, Alibaba. Firstly, based on the data from the first three rounds (1399 respondents), a SaaSQual of operationalizing perceived e-service quality of SaaS was developed, and its four dimensions (ease of use, security, reliability and responsiveness) were identified. Secondly, based on the data from the fourth round (1532 respondents), it was found that the level of three user perceptions (e-service quality, usefulness, and social influence) were predictive of the users' behavioral intention to use SaaS, and their direct and indirect influences were tested. This study recommends engineering improvements to SaaS based upon a better understanding of the level of user acceptance of this service.

1. Introduction

With the rapid advance in the availability of computer services and the widespread use of standard and open Internet technology, Software as a Service (SaaS) has become a focus for new product development within many IT, Internet and software companies. As defined by Carraro and Chong (2006) of Microsoft Corporation, SaaS is "software deployed as a hosted service and accessed over the Internet." As a process, SaaS is characterized by the use of servers to host applications that customers access over the Internet. This technology has led to a proliferation of services and applications, almost beyond imagination.

In recent years, there is a growing concern regarding the acceptance of SaaS by users (Benlian et al., 2011; Wu, 2011b; Wu et al., 2011). Researchers have tried to measure customer satisfaction as it relates to the use of SaaS. Much attention has been focused upon trying to objectively measure e-service quality in system and software performance (Benlian et al., 2011). In addition to this objective approach, others have examined social and personal factors within the user population as a determinant of the level of user acceptance of SaaS. This latter approach is evident in the technology acceptance model 2 (TAM2). The underlying objective of this research is to construct a systemic model to analyze user acceptance of SaaS. To do so, this paper employs the classic technology acceptance model (TAM) and its modified versions.

Besides identifying the factors that may influence user acceptance of SaaS, we also pay heed to the mechanisms behind these effects. Few studies have explored these mechanisms in depth. TAM has not been used for determining the mechanisms of user acceptance of SaaS. In particular, how e-service quality and social and personal factors interact with each other is oftentimes neglected by SaaS researchers and the practitioners.

Simply stated, the managers of SaaS service providers need to know how to measure e-service quality of SaaS, what aspects of SaaS service best define its quality, and whether users actually intend to use SaaS service from firms that have the highest level of perceived e-service quality or based upon other social and personal factors.

By examining user acceptance of SaaS systemically, this paper proposes an analytical framework by which to expose the significant factors and their mechanisms of action. The remainder of this paper is organized as follows. In Section 2, issues related to user acceptance of SaaS are discussed. In Section 3, a proposed analytical framework is developed. In Section 4, an empirical methodology is described for the development of SaaSQual and the measurement variables. In Section 5, the results of the empirical study from customers of China's leading e-commerce company, Alibaba, are presented and analyzed. In Section 6, the theoretical and practical

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implications are discussed, and the limitation and future direction are also given. In section 7, conclusions to be drawn from this research are presented.

2. Issues related to user acceptance of SaaS

2.1. SaaS and its characteristics

SaaS is a new software application extending the idea of the ASP (Application Service Provider). As a software delivery model providing online service, SaaS has the advantage of reducing costs, improving efficiency, lowering risk, and increasing flexibility compared to the traditional software-as-product model. It is widely considered to have a very promising future.

Although not all SaaS applications share the same traits, there are three basic characteristics common to most SaaS applications: (i) under the typical SaaS business model, providers charge a subscription fee for each application which users pay in relation to the level of service they access (Ma and Seidmann, 2008); (ii) the software and data are centrally hosted by the service provider utilizing a single-instance, multi-tenant architecture (Chong and Carraro, 2006; Susarla et al., 2010); and (iii) SaaS relies predominantly on the Worldwide Web and is typically accessed by customers over the Internet (Chong, 2008). Because software as a service is delivered to users over networks, many issues arise related to service quality that impact customer acceptance of SaaS (Benlian et al., 2011; Wu, 2011a).

2.2. Technology acceptance

Employing the theory of reasoned action (TRA), Davis (1985) first proposed the technology acceptance model, using behavioral science to explain individual acceptance of IT. For two decades, researchers made numerous improvements to this model to better understand user acceptance of information systems. To synthesize this research, a Unified Theory of Acceptance and Use of Technology (UTAUT) was put forward (Närman et al., 2012; Venkatesh et al., 2003), and researchers in this field were very satisfied with the progress they had made.

The literature on user acceptance of information technology states that an individual's behavioral intention to use a specific IT product is the direct indicator of his/her actual use. Thus *behavioral intention to use* is the dependent variable (Chau and Hu, 2001; Yi et al., 2006). It is broadly posited that *perceived usefulness*, *perceived ease of use*, and *social influence* are three important direct determinants of behavioral intention to use (Davis, 1985, 1989; Venkatesh and Davis, 2000). But the impacts of these three factors are moderated by gender, age, experience, and voluntariness of use, among others (Venkatesh et al., 2003).

2.3. E-service quality

Service quality as evaluated by the customers is the difference between how the service is delivered and how the user expected it to be delivered (Grönroos, 1984). There have been two classic approaches to the study of service quality. The first was SERVQUAL (Parasuraman et al., 1985, 1988), which are customers' perceptions-minus-expectations measures of service quality. The second was SERVPERF (Cronin and Taylor, 1992, 1994), which are performance-based measures of service quality. Both measures confirmed and empirically tested five dimensions of service quality (tangibles, reliability, responsiveness, assurance, and empathy) by conducting a survey using a standard questionnaire consisting of 22 items but employing difference function to measure the quality of service.

Table 1
Classic e-service quality evaluation scales.

Scholars	Industry	Scale name and dimensions
Yoo and Donthu (2001)	B2C	**SITEQUAL**, includes four dimensions and 9 questions: *Ease of Use, Esthetic Design, Processing Speed, Security*
Loiacono et al. (2002)	B2C	**WebQual**™, includes four dimensions, twelve factors and 36 questions: *Usefulness, Ease of Use, Complimentary, Relationship*
Barnes and Vidgen (2002)	B2C	**WebQual 4.0**, includes three dimensions and 22 questions: *Usability, Information Quality, Service Interaction Quality*
Wolfinbarger and Gilly (2003)	B2C	**eTailQ**, includes four dimensions and 14 questions: *Website Design, Reliability/Fulfillment, Security/Privacy, Customer Service*
Sigala (2004)	ASP	**ASP-Qual**, includes ten dimensions and 41 questions: *Tangibles, Reliability, Responsiveness, Assurance, Empathy, Trust, Business Understanding, Benefit and Risk Share, Conflict, Commitment*
Parasuraman et al. (2005)	B2C	Two scales for e-service quality evaluation. **E-S-QUAL**, includes four dimensions, 22 questions: *Efficiency, Fulfillment, System Availability, Privacy* **E-RecS-QUAL**, includes three dimensions, 11 questions: *Responsiveness, Compensation, Contact*

In our research, we try to follow the traditional five dimensional measure of service quality. However, electronic service (e-service) may differ somewhat from traditional service (Parasuraman et al., 2005). E-service is defined as using technology media for service delivery based on modern communications, information and multimedia technology (Wu et al., 2008). Traditional evaluations of service quality have not been effective in measuring quality in the emerging e-service media (Parasuraman et al., 2005). For example, tangibles become less important in e-service quality, because e-service is web-based and ubiquitous (Rust and Lemon, 2001). Empathy also becomes less important, because most e-service is designed for human–computer interaction rather than human–human interaction. However, reliability, responsiveness, assurance (or security) of traditional service quality are still the important factors of e-service quality. Also, ease of use is accepted by the literature as an important factor reflecting e-service quality (Davis, 1985, 1989; Yoo and Donthu, 2001).

Currently, studies on e-service are mostly conducted in the online B2B shopping segment. Despite some differences in the scales derived from these studies that focus on different fields of e-service, a review of the literature reveals a number of common dimensions identified: such as ease of use for website design, reliability of service delivery, security/privacy, and customer service responsiveness (see Table 1).

Thus, these four dimensions are emphasized repeatedly by e-service industry experts, consultants, users and literature. In this paper, we focus on the field of SaaS, so we employ these four dimensions to construct the theoretical model for evaluating e-service quality of SaaS, rather than borrow the scales of other fields of e-service studies. These four dimensions are comprehensive enough to reflect the features of SaaS quality, and focused enough to ferret out the mechanisms of user acceptance of SaaS.

3. Analytical framework

3.1. Perceived usefulness

Perceived usefulness, for the purpose of this paper, is defined as the extent to which an individual believes that using SaaS would improve his/her job performance. On the operation side, the fees paid by customers vary from application to application, depending on the type of subscription. The application architecture of SaaS is a single-instance, multi-tenant model, with service provider hosting applications and deploying software. Additionally, customers can access SaaS over the Internet easily. The biggest difference between SaaS and commonly used software lies in the user's perception of control over the business data (Wu, 2011a). These features not only foster a highly efficient and flexible access to the service, but also provide customers with a safer environment in which to access SaaS applications, while reducing costs and risk at the same time. This makes SaaS a valuable service to companies.

Currently, scholars in the field of technology acceptance agree that perceived usefulness is a vital factor that affects behavioral intention to use (Davis, 1989). Review of the TAM model shows that 16 of the 19 studies that tested the impact of perceived usefulness on behavioral intention concluded there was a significant effect, while only three concluded otherwise (Legris et al., 2003). Therefore, we propose the following hypothesis:

H1. Perceived usefulness has a positive impact on behavioral intention to use SaaS.

3.2. E-service quality

Little attention has been paid to SaaS service quality. As Novak (2010) pointed out, quality of service can be illustrated in attributes such as response time, software reliability and security. Does the scale of e-service quality in the traditional B2C context apply in a SaaS system?

Because access to SaaS affords customers a service rather than a product, they may have reservations about ease of use, data security, network reliability, and customer service responsiveness, all of which impact perceived usefulness. These impacts, to various degrees, affect customers' behavioral intention to use this new software model. The relationship between E-service quality and behavioral intention to use has been widely verified in prior studies of ASP (Günther and Tamm, 2002; Susarla et al., 2003). Quality of service should greatly influence the customers' decision to adopt a new service (Shin, 2010). Therefore, we propose the following hypotheses:

H2. E-service quality has a direct positive impact on perceived usefulness of SaaS.

H3. E-service quality has a direct positive impact on behavioral intention to use SaaS.

H4. E-service quality has an indirect positive impact on behavioral intention to use SaaS through perceived usefulness.

3.3. Ease of use

Ease of use of SaaS is determined by the customers mainly on the individual, rather than managerial, level. Although senior managers have the authority to choose whether to subscribe to SaaS, they are not the actual end users of the service. Whether the individuals who actually use SaaS can apply it effectively in their daily work determines whether SaaS is of real value to the customers. A key selling point for a SaaS system is its ease in starting and the shorter time it takes to implement a new patch for an update. Customers who purchase SaaS obtain remote access to the service through the Internet, allowing access to be gained freely from multiple workstations throughout the office. This ready access should be perceived as a greater advantage over traditional down-loaded software for internal use only.

It is now widely acknowledged in the technology acceptance field that ease of use is one of the critical factors shaping behavioral intention to use; moreover, ease of use constitutes an indirect impact on behavioral intention to use by influencing users' perceived usefulness (Davis, 1985, 1989; Szajna, 1996; Taylor and Todd, 1995; Venkatesh and Davis, 2000; Venkatesh et al., 2003). The study of the TAM model illustrates that 21 out of the 26 studies testing the effect of perceived ease of use on perceived usefulness had significant results, while only five were insignificant; 10 of the 13 studies testing the effect of perceived ease of use on behavior intention were significant, while three were insignificant (Legris et al., 2003). In addition, a large body of evidence also demonstrates that ease of use plays an important part in service quality, correlating significantly with user behavior intention (Barnes and Vidgen, 2002; Parasuraman et al., 2005; Santos, 2003; Sigala, 2004; Wolfinbarger and Gilly, 2003; Yoo and Donthu, 2001). Hence, it is hypothesized that:

H2a. Ease of use has a direct positive impact on perceived usefulness of SaaS.

H3a. Ease of use has a direct positive impact on behavioral intention to use SaaS.

H4a. Ease of use has an indirect positive impact on behavioral intention to use SaaS through perceived usefulness.

3.4. Security

Security concerns arise while using SaaS because the process requires the transfer and storage of the customer's personal information. Since the user logs onto the Internet to access and store data, it must sacrifice, to some extent, control over data relating to its products, customers and suppliers – information that is a key asset in its business operations. Therefore, in spite of the technological benefits of the various applications available through SaaS, users may be leery about accepting the security risks attendant to SaaS.

There are two different views on SaaS security. On the one hand, it is widely acknowledged that SaaS user data is generally maintained in special databases, the security of which can be comparable with that of banks. On the other hand, with a more traditional point of view, it is still risky to use SaaS system because the crucial data about financial and customer information is stored on the vendor's server. Therefore, it may be leaked or abused at any time without the customers having any control. The IDC (2007) report documents that data security is the most common hurdle that customers must overcome before becoming accepting of SaaS. In addition, any risk of malfunction of the server or the network may be unacceptable to customers especially for segments of their business operations that are critical. Considering the above, it is not surprising that in multiple studies of ASP, guarantees of security reduce customer anxiety, thus improving the perceived usefulness of this online service (Günther and Tamm, 2002; Susarla et al., 2003). Although it was not confirmed in Wolfinbarger and Gilly (2003)'s study that security has an impact on users' behavioral intentions, an empirical study of Amazon and Wal-Mart, the B2C website, found that security and user behavior intention do have a significant correlation (Parasuraman et al., 2005). Therefore, we hypothesize that:

H2b. Security has a direct positive impact on perceived usefulness of SaaS.

H3b. Security has a direct positive impact on behavioral intention to use SaaS.

H4b. Security has an indirect positive impact on behavioral intention to use SaaS through perceived usefulness.

3.5. Reliability

Reliability is the ability of the service provider to deliver accurate and consistent service (Santos, 2003). In terms of system operation, reliability means the extent to which the system operates correctly (Parasuraman et al., 2005). Hence, this paper regards SaaS reliability as the extent to which the SaaS system runs correctly when individuals are using it. A survey was conducted on the ASP usage of the German listed companies and found that reliability is one of the three most important concerns (Günther and Tamm, 2002).

Users are less likely to accept an unexpected breakdown of the server or network when it involves business-critical operations. Such emergencies are likely to erode the customers' behavioral intention to use SaaS. Multiple studies on ASP have shown that service reliability is one of the major issues when using online software. Therefore, a service provider's guarantee of service reliability should improve the customers' perception of the usefulness of the online software. Based on this, we hypothesize that:

H2c. Reliability has a direct positive impact on perceived usefulness of SaaS.

H3c. Reliability has a direct positive impact on behavioral intention to use SaaS.

H4c. Reliability has an indirect positive impact on behavioral intention to use SaaS through perceived usefulness.

3.6. Responsiveness

Responsiveness has been described as the ASP's capability to solve customer problems on time (Sigala, 2004). Considering that SaaS is an emerging software application accessed over a network, users who have been accustomed to offline software may confront a variety of problems adjusting to the SaaS process, and these problems need to be resolved by the service provider. Three dimensions – service level, reliable network security and service response time – are used to assess a service provider's guarantee of superior technical service (Susarla et al., 2003), and empirical results show that an effective guarantee can reduce customer anxiety and boost perceived service performance.

A study of ASPs demonstrates that service response time is one of the most important issues that customers care about when using online software (Susarla et al., 2003). If employees from the service provider are able to solve the customers' problems promptly, it will definitely enhance the customers' perception of service value, thus improving their behavioral intention to use as well. Therefore, we propose the following hypotheses:

H2d. Responsiveness has a direct positive impact on perceived usefulness of SaaS.

H3d. Responsiveness has a direct positive impact on behavioral intention to use SaaS.

H4d. Responsiveness has an indirect positive impact on behavioral intention to use SaaS through perceived usefulness.

3.7. Social influence

We define social influence as the extent to which an individual perceives that others of importance believe he or she should use the new system (Venkatesh et al., 2003). It is believed that the wide use of online software is likely to enhance the size of the user community based on common interests. While employing SaaS, customers can make friends and exchange ideas within a community, with social influence working during this process.

In the theory of reasoned action (TRA) model, subjective norms constitute a direct determinant of behavioral intention (Fishbein and Ajzen, 1975). Furthermore, in the TAM2, social factors including subjective norms, image and voluntariness are certified to have effects on user perception of usefulness and behavioral intention to use a new information system (Venkatesh and Davis, 2000). Although several studies have found the effect of social influence on behavioral intention to use to be insignificant (Davis et al., 1989; Mathieson, 1991), multiple follow-up studies have supported the conclusion that social factors do have an impact on behavioral intention to use (Lucas and Spitler, 1999; Taylor and Todd, 1995; Venkatesh et al., 2003). Especially when subscribing to a new service, customers rely on the views and experiences of others to make decisions. This social influence has a positive influence on behavioral intention to use (Shin, 2010). Thus, we propose these hypotheses:

H5. Social influence has a direct positive impact on perceived usefulness of SaaS.

H6. Social influence has a direct positive impact on behavioral intention to use SaaS.

H7. Social influence has an indirect positive impact on behavioral intention to use SaaS through perceived usefulness.

In summary, the model of this study has now been constructed in its entirety as shown in Fig. 1.

4. Methods

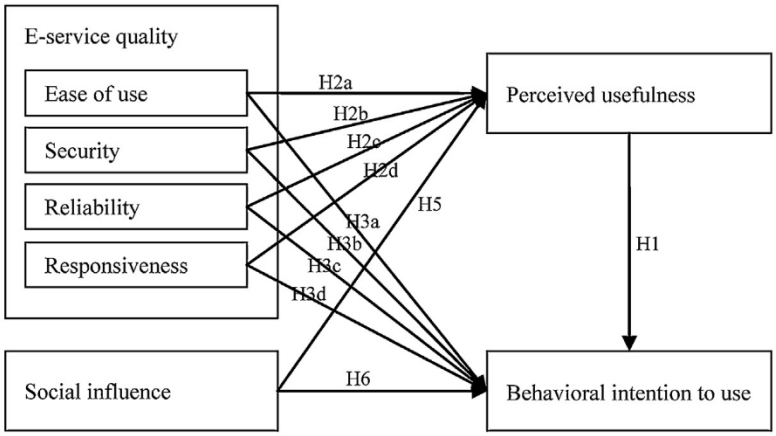
4.1. Research setting

This paper proposes a model with which to analyze the user acceptance of SaaS. The factors impacting the user acceptance of SaaS are illustrated theoretically. We tested our hypotheses in the context of China's booming SaaS engineering market. The user acceptance of SaaS business will largely determine the future competitive position of SaaS providers. These companies are using a variety of ways to attract users to accept the SaaS. This provides us with an excellent research setting in which to test our theoretical hypotheses.

Although research on the scale of e-service quality is abundant, research on the scale of e-service quality of SaaS is not. It is not clear whether the classic scales of e-service quality could be borrowed and applied to the field of SaaS directly because of the unique characteristics of SaaS. Thus, firstly, we had to develop an original SaaSQual from SaaS practitioners who keep in close touch with SaaS engineering and know what the essence of e-service quality of SaaS exactly means. We collected their opinions through open questionnaires. Those initial questionnaires, combined with the classical descriptions of scales of e-service quality, allowed us to construct and design the initial SaaSQual questionnaire. Secondly, we conducted a pre-survey with small samples to verify our assumption about the dimensions of e-service quality of SaaS. Thirdly, we conducted a large-scale survey, in order to clarify the meaning of items and to ensure high reliability of the final scale of SaaSQual. Finally, we conduct a large-scale survey to test our model of user acceptance of SaaS.

4.2. Data collection strategy

This study was supported by Alibaba Software (Shanghai) Ltd. founded in January, 2007. Alibaba Software is the fifth subsidiary



H2:"E-service quality"→ "Perceived usefulness"
H3:"E-service quality"→ "Behavioral intention to use"
H4:"E-service quality"→ "Perceived usefulness"→"Behavioral intention to use"
H4a: "Ease of use"→"Perceived usefulness"→"Behavioral intention to use"
H4b: "Security"→"Perceived usefulness"→"Behavioral intention to use"
H4c: "Reliability"→"Perceived usefulness"→"Behavioral intention to use"
H4d: "Responsiveness"→"Perceived usefulness"→"Behavioral intention to use"
H7:"Social influence"→ "Perceived usefulness"→"Behavioral intention to use"

Fig. 1. A research model of user acceptance of SaaS. H = hypothesis.

of Alibaba Group, China's largest e-commerce service provider. According to the report of Analysys International – the leading provider of information product, service and solution in China Internet market – in just one year, Alibaba Software had grown to became China's largest SaaS company with a market share of 67% in 2007. At the same time, it was also the world's second largest SaaS provider, trailing only the industry leader, Salesforce. The growing ranks of customers of Alibaba are an excellent sample for the study of user acceptance of SaaS.

Four rounds of survey questionnaires were conducted online. These questionnaires were distributed to two different Alibaba management software websites (its online shop management software website, and its online user management software website). We collected six groups of samples (see Table 2). The first four groups of samples were used to develop a scale to evaluate e-service quality – SaaSQual. The last two groups of samples were used to test the model of user acceptance of SaaS.

4.3. SaaSQual development and variables measurement

Because of the unique characteristics of SaaS, we did not borrow an existing scale, but instead developed a new scale – SaaSQual – after consulting the literature on traditional service quality, and e-service quality, and the information provided by actual users.

In the first round of the survey, we distributed an open questionnaire online and received valid answers from 311 respondents (shown in Table 2). We asked these respondents a question "what issue are you most concerned about in using online shop management software, except the function and price?" The respondents were instructed to identify only their single most important issue, and we controlled the function and price factors in the design of the question, leading users to think about the issue related to e-service quality of SaaS.

Through semantic analysis of each response we received, six factors connected with e-service quality of SaaS were identified: ease of use, security, reliability, responsiveness, personality and compatibility (shown in Fig. 2). The first four factors were highly emphasized by users and consistent with the four factors identified in the literature. However, the last two factors, personality and compatibility were seldom mentioned (less than 10% of respondents). Thus, only the first four significant factors were selected as the dimensions of e-service quality of SaaS. Then, after considering measurement tools from previous studies, we designed an initial 7-point Likert scale of SaaSQual with 16 items (shown in Table 3).

In the second round of the survey, we endeavored to test the initial scale of SaaSQual with small samples (including 76 valid respondents shown in Table 2) by conducting exploratory factor analysis (EFA) to verify our assumption of the four dimensions of e-service quality of SaaS. This round of the survey was treated as a pre-survey. The pre-survey questionnaire served to maximize the reliability and validity of the initial scale of SaaSQual with small samples before conducting the formal large sample survey. It provided a mechanism for us and the respondents with practical experience to collaborate more productively in assessing the initial SaaSQual we developed. By testing and completing the SaaSQual questionnaire before the formal large sample survey, we received

Table 2
Data collection from SaaS users.

Collection time	Sample groups	Distributed SaaS type	Valid respondents
1st round survey	1	Online shop management software	311
2nd round survey	2	Online shop management software	76
3rd round survey	3	Online shop management software	499
	4	Online user management software	513
4th round survey	5	Online shop management software	673
	6	Online user management software	859

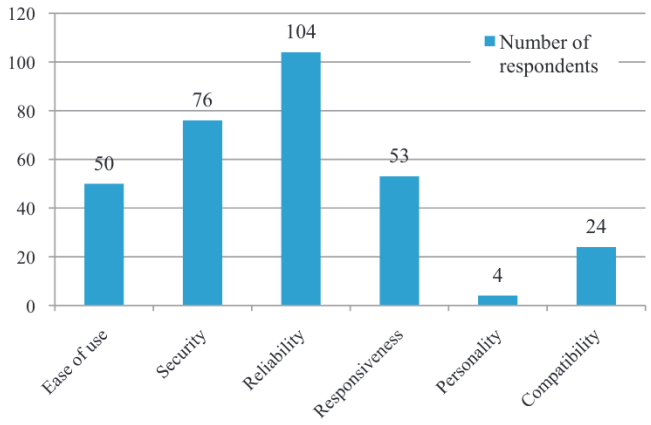


Fig. 2. The survey results on essence of e-service quality of SaaS (311 respondents). *Note:* Dashed lines describe statistically insignificant paths which are removed in the final model.

important information in advance that might otherwise take hours to extract on-site.

Additionally, the pre-survey questionnaire served as a valuable instrument that alerted us to areas of possible non-conformity with the previous literature. The Cronbach's α of the respective four variables' subscales were all above 0.8, which proved the consistency and stability of the initial SaaSQual (shown in Table 3). It also supported our expectation that the four factors identified from the first round of open questionnaire online were basically the same as the findings from the literature study.

In the third round of the survey, we used a closed questionnaire to purify and refine the SaaSQual by conducting confirmatory factor analysis (CFA). 1012 valid respondents were investigated, including 499 respondents coming from the online shop management software survey and 513 respondents coming from the online user management software survey (shown in Table 2). Consistent with the methodology for purifying items (Loiacono et al., 2002; Parasuraman et al., 2005; Wolfinbarger and Gilly, 2003), we deleted the item EOU4 which lowered Cronbach's α of the ease of use scale. We also deleted the item SEC4, because its corrected item – total correlation (CITC) – was less than 0.5. After that, the KMO was 0.880 and the Bartlett's test of sphericity was significant, which confirmed the reliability of the scale and the feasibility to conduct CFA.

To further increase the response rate of the questionnaire, each variable reserved the top three largest loading items (Loiacono et al., 2002). Thus, REL4 and RES4 were deleted (shown in Table 3). We examined the reliability and validity of the final SaaSQual containing 12 items. The least Cronbach's α of four subscales is 0.807 (above 0.7). The least average variance extracted (AVE) of four subscales is 0.587 (above 0.5). Thus, the scale of SaaSQual we developed had high reliability and validity, and it could be used to measure the e-service quality of SaaS.

In the fourth round of the survey, we used a final closed questionnaire to collect the data of SaaS users from the 1532 valid respondents, including 673 respondents from the online shop management software survey and 859 respondents from the online user management software survey (shown in Table 2).

The four variables of e-service quality of SaaS were measured by the SaaSQual this study developed. The other two explanatory variables in our model are perceived usefulness (Davis, 1989) and social influence (Venkatesh et al., 2003). Behavioral intention to use (Venkatesh et al., 2003; Zeithaml et al., 1996) is the explained variable in this paper. We used the existing scale to measure the three variables (shown in Table 4).

4.4. Demographic characteristics

After four rounds of the survey, we collected data from valid respondents for developing SaaSQual and tested the model of user acceptance of SaaS. Table 5 summarizes the demographic characteristics of these valid respondents.

5. Results

5.1. Reliability and validity

The analysis of reliability and validity of variables in this study is confirmed by the data from the 1532 respondents in the fourth

Table 3
Initial SaaSQual and final SaaSQual.

Variables	Items	Description of items	References	AVE	Cronbach's α
Ease of use	EOU1[a,b]	Learning to operate XYZ would be easy for me.	Davis (1989)	0.710[b]	0.880[a]/0.877[b]
	EOU2[a,b]	It would be easy for me to become skillful at using XYZ.			
	EOU3[a,b]	My interaction with XYZ would be clear and understandable.			
	EOU4[a]	I would find it easy to get XYZ to do what I want it to do.			
Security	SEC1[a,b]	I feel like my privacy is protected at XYZ.	Wolfinbarger and Gilly (2003)	0.789[b]	0.912[a]/0.917[b]
	SEC2[a,b]	I feel that the operation at XYZ is secure.	Sigala (2004)		
	SEC3[a,b]	Nobody can access my private data saved at XYZ only if authorized by me.	Open questionnaire		
	SEC4[a]	XYZ does not share my personal information with others.	Parasuraman et al. (2005)		
Reliability	REL1[a,b]	XYZ quickly delivers what I order.	Parasuraman et al. (2005)	0.587[b]	0.911[a]/0.807[b]
	REL2[a,b]	XYZ runs on reliable and secure networks and datacenters.	Sigala (2004)		
	REL3[a,b]	XYZ makes services available for delivery within a suitable time frame.	Parasuraman et al. (2005)		
	REL4[a]	XYZ insists on providing a long-term service.	Open questionnaire		
Responsiveness	RES1[a,b]	XYZ provides me with convenient options for help.	Parasuraman et al. (2005)	0.749[b]	0.974[a]/0.898[b]
	RES2[a,b]	XYZ tells user exactly when services will be performed.	Sigala (2004)		
	RES3[a,b]	XYZ's employees are never too busy to respond to users' requests.	Sigala (2004)		
	RES4[a]	XYZ tells me what to do if I have questions.	Parasuraman et al. (2005)		

Note: agree–disagree scale: 1 = 'strongly disagree', 7 = 'strongly agree'.
[a] Initial SaaSQual.
[b] Final SaaSQual.

Table 4
Measurement of the social influence, perceived usefulness and behavioral intention to use.

Variables	Items	Description of items	References
Social influence	SI1	People who influence my behavior think that I should use XYZ.	Venkatesh et al. (2003)
	SI2	People who are important to me think that I should use XYZ.	
	SI3	The senior management of this business has been helpful in the use of the system.	
Perceived usefulness	PU1	Using XYZ in my job would enable me to accomplish tasks more quickly.	Davis (1989)
	PU2	Using XYZ would enhance my effectiveness on the job.	
	PU3	Using XYZ would make it easier to do my job.	
Behavioral intention to use	BI1	I predict I would use XYZ in the next ⟨*n*⟩ months.	Venkatesh et al. (2003)
	BI2	Say positive things about XYZ to other people.	Zeithaml et al. (1996)
	BI3	Recommend XYZ to someone who seeks my advice.	Zeithaml et al. (1996)

Table 5
Demographic information of valid respondents in the second, third and fourth round survey.

Classification		2nd survey	3rd survey		4th survey	
		Group 2 (*N* = 76)	Group 3 (*N* = 499)	Group 4 (*N* = 513)	Group 5 (*N* = 673)	Group 6 (*N* = 859)
Gender	Male	30 (39.5%)	222 (44.5%)	419 (81.7%)	322 (47.8%)	708 (82.4%)
	Female	46 (60.5%)	277 (55.5%)	94 (18.3%)	351 (52.2%)	151 (17.6%)
Age	≤20	1 (1.3%)	7 (1.4%)	15 (2.9%)	18 (2.7%)	28 (3.3%)
	21–25	31 (40.8%)	164 (32.9%)	186 (36.3%)	243 (36.1%)	311 (36.2%)
	26–30	26 (34.2%)	234 (46.9%)	179 (34.9%)	288 (42.8%)	278 (32.4%)
	31–35	12 (15.8%)	76 (15.2%)	78 (15.2%)	94 (14.0%)	129 (15.0%)
	≥36	6 (7.9%)	18 (3.6%)	55 (10.7%)	30 (4.5%)	113 (13.2%)
Education	Junior high school	2 (2.6%)	5 (1.0%)	13 (2.5%)	18 (2.7%)	40 (4.7%)
	Senior high school	24 (31.6%)	80 (16.0%)	115 (22.4%)	105 (15.6%)	195 (22.7%)
	Junior college	29 (38.2%)	187 (37.5%)	228 (44.4%)	251 (37.3%)	353 (41.1%)
	Undergraduate	21 (27.6%)	205 (41.1%)	142 (27.7%)	271 (40.3%)	253 (29.5%)
	Graduate	0 (0)	22 (4.4%)	15 (2.9%)	28 (4.2%)	18 (2.1%)

Note: samples of group 2, 3, 5 are from online shop management software surveys, and samples of group 4, 6 are from online user management software surveys.

round. The reliability of all instruments assessed by the Cronbach's α coefficients are above 0.7 as shown in Table 6. Confirmatory factor analysis (CFA) demonstrated the unidimensionality, convergent and discriminant validity of the multi-item measures of each construct as displayed in Table 6 (Netemeyer et al., 1990).

5.2. Tests of hypotheses

The model proposed in the study was tested with structural equation modeling (SEM) using AMOS 7.0 (Bagozzi and Yi, 1998). To assess the model M_0, multiple fit indices were computed using the data from 673 respondents. The data were generally consistent with our hypothesized structure. The fit statistics were all indicative of good fit ($\chi^2 = 345.701$, $\chi^2/df = 2.058$, RMSEA = 0.040, CFI = 0.985, TLI = 0.981). But two paths are insignificant which are "reliability → perceived usefulness" and "security → behavioral intention to use." Firstly, we removed the path of "security → behavioral intention to use" and got the model M_1. Then, we removed another path of "reliability → perceived usefulness" and got the model M_2. Table 7 shows the fit indices of the three models. We accepted M_2 as the final model and used mixed samples (1532 respondents) to examine it. Fig. 3 presents the final model with the insignificant paths removed. Table 8 shows the results of all hypothesis tests.

Table 6
Results of reliability and validity tests (1532 respondents).

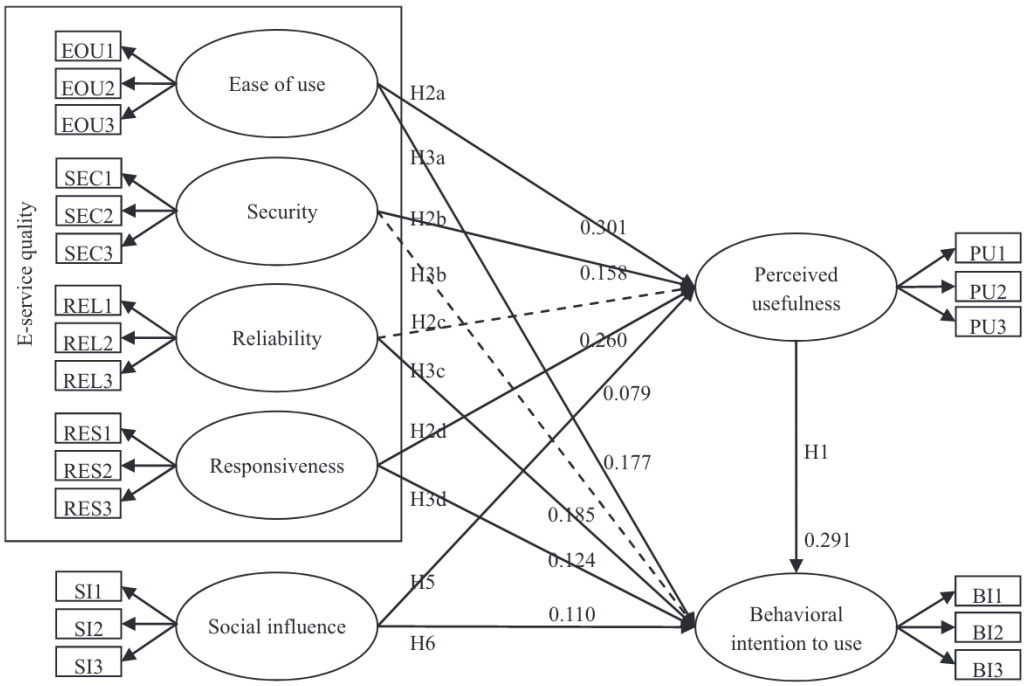
Variables	Items	Factor loading	AVE	Cronbach's α
Ease of use	EOU1	0.834	0.745	0.931
	EOU2	0.940		
	EOU3	0.810		
Security	SEC1	0.891	0.849	0.845
	SEC2	0.931		
	SEC3	0.942		
Reliability	REL1	0.834	0.707	0.923
	REL2	0.858		
	REL3	0.831		
Responsiveness	RES1	0.885	0.847	0.893
	RES2	0.944		
	RES3	0.931		
Social influence	SI1	0.712	0.790	0.935
	SI2	0.971		
	SI3	0.959		
Perceived usefulness	PU1	0.907	0.834	0.886
	PU2	0.919		
	PU3	0.913		
Behavioral intention to use	BI1	0.859	0.821	0.911
	BI2	0.968		
	BI3	0.887		

The results support hypotheses H1, H5, H6 and H7. In the context of SaaS, perceived usefulness positively relates to behavioral intention to use ($\gamma_1 = 0.291$). Social influence positively relates to perceived usefulness ($\gamma_5 = 0.079$) and behavioral intention to use ($\gamma_6 = 0.110$) and the impact of social influence on the behavioral intention to use is partly mediated by perceived usefulness ($\gamma_5 * \gamma_1 = 0.023$). All of the results are consistent with the conventional wisdom of the past (Lucas and Spitler, 1999; Taylor and Todd, 1995; Venkatesh and Davis, 2000; Venkatesh et al., 2003).

At the same time, the results partially support H2. E-service quality is positively related to perceived usefulness ($\gamma_{2a} + \gamma_{2b} + \gamma_{2c} + \gamma_{2d} = 0.742$). But the four dimensions of the e-service quality have different effects on perceived usefulness ($\gamma_{2a} = 0.301$, $\gamma_{2b} = 0.158$, $\gamma_{2c} = 0$, $\gamma_{2d} = 0.260$). Only the relationship between reliability and perceived usefulness is not supported. One actual explanation is that perceived usefulness is mainly related to the function modules of SaaS itself, however, reliability is related to many factors which impact the operation of the SaaS system. For

Table 7
Fit indices of M_0, M_1 and M_2.

Model	χ^2	df	*P*	χ^2/df	TLI	CFI	RMSEA
M_0	345.701	168	0.000	2.058	0.981	0.985	0.040
M_1	345.984	169	0.000	2.047	0.981	0.985	0.039
M_2	346.293	170	0.000	2.037	0.982	0.985	0.039



Note: Dashed lines describe statistically insignificant paths which are removed in the final model.

Fig. 3. Path coefficient of full model (1532 respondents).

example, if customers cannot connect to the SaaS system, this may be caused by a software or a hardware problem, by a problem with local network service, or even by other unpredictable causes. So users cannot always place the blame on the SaaS system, and their perception about the usefulness of SaaS may not be dramatically impacted. Unlike reliability, the other three determinants (ease of use, security, and responsiveness) impact directly the perceived usefulness of the SaaS itself.

The results also partially support H3. E-service quality is positively related to behavioral intention to use ($\gamma_{3a}+\gamma_{3b}+\gamma_{3c}+\gamma_{3d}=0.483$). But the four dimensions of e-service quality have different effects on behavioral intention to use ($\gamma_{3a}=0.177$, $\gamma_{3b}=0$, $\gamma_{3c}=0.185$, $\gamma_{3d}=0.124$). Only the relationship between security and behavioral intention to use is not supported. One possible explanation is that customers with different experiences of SaaS have divergent perceptions about its guarantee of security. Some of the respondents in our study have been using SaaS for a sufficient time to have become secure about its security, so they hardly worry about it. Whereas, other users who have used SaaS only for a short time pay have greater fears about the issue of security. In the latter situation, security will have an effect on behavioral intention to use.

H4 is also partially supported by our study. E-service quality has positive impact on behavioral intention to use partly mediated by perceived usefulness ($(\gamma_{2a}+\gamma_{2b}+\gamma_{2c}+\gamma_{2d})^{*}\gamma_1=0.167$). But perceived usefulness has different mediation effects between the four dimensions of the e-service quality and behavioral intention to use ($\gamma_{2a}{}^{*}\gamma_1=0.088$, $\gamma_{2b}{}^{*}\gamma_1=0.046$, $\gamma_{2c}{}^{*}\gamma_1=0$, $\gamma_{2d}{}^{*}\gamma_1=0.076$). The mediation effect between reliability and behavioral intention to use is not supported.

Table 8
Results of hypothesis tests (1532 respondents).

Hypotheses	Paths	Path coefficient		S.E.	C.R.	P	Results
H1	Perceived usefulness → behavioral intention to use	γ_1	0.291	0.023	10.552	0.000	Supported
H2	E-service quality → perceived usefulness	$\gamma_{2a}+\gamma_{2b}+\gamma_{2c}+\gamma_{2d}$	0.742				Supported
H2a	Ease of use → perceived usefulness	γ_{2a}	0.301	0.030	10.913	0.000	Supported
H2b	Security → perceived usefulness	γ_{2b}	0.158	0.034	5.243	0.000	Supported
H2c	Reliability → perceived usefulness	γ_{2c}	0.000				Unsupported
H2d	Responsiveness → perceived usefulness	γ_{2d}	0.260	0.035	8.297	0.000	Supported
H3	E-service quality → behavioral intention to use	$\gamma_{3a}+\gamma_{3b}+\gamma_{3c}+\gamma_{3d}$	0.483				Supported
H3a	Ease of use → behavioral intention to use	γ_{3a}	0.177	0.025	6.598	0.000	Supported
H3b	Security → behavioral intention to use	γ_{3b}	0.000				Unsupported
H3c	Reliability → behavioral intention to use	γ_{3c}	0.185	0.027	6.329	0.000	Supported
H3d	Responsiveness → behavioral intention to use	γ_{3d}	0.124	0.030	3.895	0.000	Supported
H4	E-service quality → perceived usefulness → behavioral intention to use	$(\gamma_{2a}+\gamma_{2b}+\gamma_{2c}+\gamma_{2d})^{*}\gamma_1$	0.167				Supported
H4a	Ease of use → perceived usefulness → behavioral intention to use	$\gamma_{2a}{}^{*}\gamma_1$	0.088				Supported
H4b	Security → perceived usefulness → behavioral intention to use	$\gamma_{2b}{}^{*}\gamma_1$	0.046				Supported
H4c	Reliability → perceived usefulness → behavioral intention to use	$\gamma_{2c}{}^{*}\gamma_1$	0.000				Unsupported
H4d	Responsiveness → perceived usefulness → behavioral intention to use	$\gamma_{2d}{}^{*}\gamma_1$	0.076				Supported
H5	Social influence → perceived usefulness	γ_5	0.079	0.035	2.794	0.000	Supported
H6	Social influence → behavioral intention to use	γ_6	0.110	0.028	4.169	0.000	Supported
H7	Social influence → perceived usefulness → behavioral intention to use	$\gamma_5{}^{*}\gamma_1$	0.023				Supported

6. Discussion

6.1. Theoretical implications

This paper proposes a model to analyze the user acceptance of SaaS. Firstly, this paper puts forward a SaaSQual of operationalizing perceived e-service quality of SaaS. SaaS engineering has developed in recent years. A well-developed and effective SaaSQual is valuable to help the SaaS practitioner understand the essence of e-service quality of SaaS. In our SaaSQual, four key dimensions are identified which are ease of use, security, reliability and responsiveness. This study deepens the insight from previous research of e-service quality evaluation to the specific field of SaaS which is seldom mentioned in the literature.

Secondly, it is also found that the level of three user perceptions (e-service quality, usefulness, and social influence) are predictive of the user's behavioral intention to use SaaS. This finding is consistent with the previous findings of technology acceptance research. Specifically, the e-service quality, usefulness, and social influence all have direct influences on behavioral intention to use SaaS, and e-service quality and social influence also have indirect influences on behavioral intention to use SaaS through usefulness.

Thirdly, for the purpose of studying more closely the level of user acceptance of this service, the direct and indirect influences that the four dimensions of e-service quality had on behavioral intention to use SaaS were tested. The results also suggest that three of the four dimensions of e-service quality of SaaS (ease of use, reliability and responsiveness) have a direct positive impact on behavioral intention to use SaaS; however, security was found to have only an indirect positive impact on behavioral intention to use SaaS through perceived usefulness. This finding is slightly inconsistent with the previous literature of technology acceptance. When users perceive the ease of use, reliability and responsiveness of SaaS, they feel the e-service quality is good, and they will tend to use the SaaS. However, even when users perceive to be a secure product, and, although they feel the e-service quality to be quite good, this will not translate into user acceptance until they perceive usefulness.

6.2. Practical implications for engineering improvements to SaaS

6.2.1. Improve the perceived usefulness: design practical function based on common needs

According to this research, perceived usefulness is a key factor that has an impact on a customer's decision to use SaaS. If there is no perceived usefulness, advertising hype will not persuade consumers to use the service. Therefore, the major task for SaaS providers is to determine the customers' true needs and develop practical online software, generating revenue through user agglutinant driven by excellent functionality. Since users have personalities, even the same customer will have needs that vary over time. Thus, service providers have to consider this variability when designing new SaaS functions. By collecting and analyzing user needs and preferences on a regular basis, a service provider can update its software with needed functions. In this way, SaaS is able to continually enhance work performance.

6.2.2. Improve the e-service quality: provide quality service to SaaS based on full scenarios

This study demonstrates that e-service quality is one of the crucial factors that impact behavioral intention to use. It also shows that the four dimensions of e-service quality influence behavioral intention to use through different mechanisms. Hence, the service provider should make every effort to improve the usefulness of SaaS, all the while keeping an eye on the management and enhancement of SaaS e-service quality. In addition, the SaaSQual developed in this study gives a more concrete set of criteria for service quality assessment. Using SaaSQual to conduct surveys from time to time, SaaS providers can acquire service quality evaluation on specific SaaS products, on which to base improvements and shortcuts.

Since ease of use has a significant direct positive impact on perceived usefulness and behavioral intention to use, improvements on ease of use – for example, operation guide setting, additional module mouse drag function, automatic data running and more visual and humanized interface design – should be the persistent goal of the service provider.

Although security does not impact behavioral intention to use, it significantly influences perceived usefulness in a direct positive way. Since customers with extended experience in the SaaS system possesses a better understanding of security, SaaS providers should pay more attention to potential and new users, for example, by offering greater access to trials for new users. Moreover, the following solutions can be useful to enhance security: (i) opportunities for longer free trials give users more knowledge about SaaS security; secondary authentication to a sensitive data page, with IP binding code, mobile phone binding code, USB Key, digital certificate and other security measures used in combination based on a customer's needs ensures the confidentiality of data; (ii) exporting SaaS data with diminished control by the provider may reduce a customer's worries about security, in turn, making it more likely to sacrifice some control over data in order to use SaaS; (iii) the introduction of material about the SaaS data center and third-party security certification may give assurance to customers that their data is being properly preserved; and (iv) guarantees that the employees of the service provider cannot access to customer data without permissions will enhance the customers' sense of security.

Although SaaS reliability does not significantly affect user perceived usefulness, it still plays an important role in determining behavioral intention to use. Thus, SaaS providers should improve reliability by all means. For example, committed service should be provided to users as soon as they pay, otherwise, negative impressions about reliability may be left. Since there are always problems with commonly used browsers such as Internet Explorer (for example, when users have to restart the browser when too much information is loaded on a single page), no single page of SaaS should be overloaded by data and functions. Although customers may tolerate breakdowns, they are unlikely to accept system unavailability without any notice. So when the system is not available, an official announcement is needed to ensure that users have clear understandings rather than suspicions. Moreover, the upgrading and maintenance of the system, either its hardware or software, should be arranged late at night, without interfering with the user's normal use. Even though network service reliability and web functions are already remarkable, it is critical to develop a desktop client for SaaS, which can work offline and synchronize data with the server when the network is available. Because of its better reliability and function, a Desktop Client can be a beneficial complement to network service. One of the best examples of this is that Google, long known for its network service, is launching an offline version for the reader that maps office software.

Having a direct significant impact on perceived usefulness and behavioral intention to use, responsiveness should be improved continually by the service provider. Responsiveness can be improved in the following ways: (i) provide and constantly refine the help service of SaaS, which allows users to find answers to some common problem directly; (ii) take the example of Wikipedia, build a support network using incentive measures, such as integral change to use time, to drive users to solve problem for others in the consuming community; (iii) make the response time of customer service explicit, so that users know when their problem will be solved; (iv) provide users a variety of ways to seek help, such as hotline, Email, instant messenger, and community;

and (v) build channels for close customer service to reduce the response time. Golden Abacus serves as a model for how to improve responsiveness. This domestic SaaS system provider designs two different channels, with 200,000 registered service providers in one and 1000 application providers in the other. While the registered service providers rely on development of "registered users" to gain profit, the application providers, as the complement of registered service providers, furnish users with follow-on value-added application service, and both channels necessarily support the fast responses to users' needs.

6.2.3. Improve the social influence: carry out word of mouth marketing and viral promotion

This study shows that social influence has a significant direct impact on both perceived usefulness and behavioral intention to use. Therefore using word of mouth marketing through the social network is a productive way to promote SaaS. Word of mouth marketing, a common Internet promotion also known as viral marketing, provides valuable information and service to users, then takes advantage of active communication between users to transfer information. There are many successful examples of word of mouth marketing. For instance, Google uses satisfied customers to send invitations to attract new users, thereby increasing its subscriber base without incurring advertising costs. Similarly, Baidu has adopted a viral marketing campaign to launch its instant messenger Baidu Hi, with good results. Traditional software companies, selling software as products, use television advertising, advertorial and industry conferences to promote products, while SaaS, in keeping with its character of selling software as a service, makes use of word of mouth marketing and viral promotion through the customers' social networks, as other common Internet service providers do.

U.S. Internet marketing pioneer Wilson (2012) described the six basic elements of an effective viral marketing strategy: (i) give away valuable products or services; (ii) provide for effortless transfer to others; (iii) scale easily from small to very large; (iv) exploit common motivations and behaviors; (v) utilize existing communication networks; and (vi) take advantage of others' resources. While developing and implementing a viral marketing plan, companies should conduct preliminary investigations to test their own viral marketing strategy, in order to meet the six basic elements.

6.3. Limitations and future directions

Although this study has proposed some significant innovations, and confirmed a number of important conclusions, these results are limited to some extent so that further research is needed.

Our data was collected from a single SaaS provider, and this is a limitation. In order to control for factors such as a SaaS provider's reputation, which may impact user intention to use, we selected two SaaS systems from the same provider for data collection. However, for the sake of the validity of the theory, more diverse samples of different SaaS types and different user groups should be gathered to test the model.

Another area for improvement is the study on exogenous variables. The model of impacts on SaaS acceptance in this study mainly focuses on the relationships between behavioral intention to use and attitudinal factors such as perceived usefulness, the quality of electronic services and social influence, but lacks a further exploration on how behavioral intention to use determines use behavior and how exogenous variables such as gender, age, experience, and voluntariness influence a user's attitudes. Follow-up studies can further explore the impact of exogenous variables on formation and change of belief, and relationship between behavioral intention to use and use behavior.

Due to the limited research conditions, we mainly collected cross-sectional data, which can only reveal the static law at one point in time, and lacks span study. As a matter of fact, factors that influence users' acceptance of technology vary from time to time. Further research should collect relevant data from different time points to track SaaS usage so as to analyze factors that influence behavioral intention to use and find out how these factors work.

User technology acceptance research in the context of electronic service, one of the most challenging areas in the information system, has a pressing practical use. Exploratory research in this paper is only a preliminary attempt, with the proposed model, idea and methods to be tested by further theoretical and empirical research. But it should serve as the reference for follow-up study.

7. Conclusions

The present research proposes a model with which to analyze the user acceptance of Software as a Service (SaaS). Firstly, a SaaSQual of operationalizing perceived e-service quality of SaaS was developed, and its four dimensions (ease of use, security, reliability and responsiveness) were identified; secondly, it was found that the level of three user perceptions (e-service quality, usefulness, and social influence) were predictive of the user's behavioral intention to use SaaS, and their direct and indirect influences were tested.

Our work recommends engineering improvements to SaaS based upon a better understanding of the level of user acceptance of this service. Generally speaking, e-service quality, usefulness, and social influence are the three key factors for SaaS engineering improvements. Our work indicates that SaaS engineering should design practical function based on common needs, provide quality service to SaaS based on full scenarios, and carry out word of mouth marketing and viral promotion. Taking e-service quality of SaaS into account, it is if more value to improve ease of use, reliability and responsiveness than to improve security as a way to promote greater user acceptance of SaaS.

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